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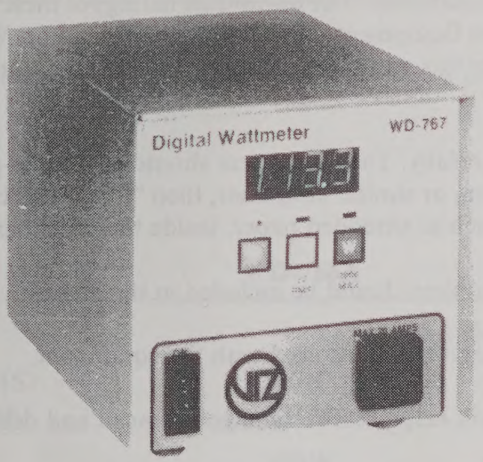
Instruction Manual for

WD-766A 1KW, 10A
WD-767 2KW, 20A
AC/RMS DIGITAL WATTMETERS



WD-767
2KW, 3.5 Digit Display

Test Equipment

VIZ TEST EQUIPMENT
A KAPPA NETWORKS Division
175 Commerce Drive, Fort Washington, PA 19034
Telephone 215-643-6950 Toll Free 1-800-523-3696 FAX 215-643-5237

PRICE $2.75

Safety Precautions

Care should be exercised whenever testing electrical equipment that is operated from an AC Power Line or other high voltage sources..... There is always the danger of electrical shock from these circuits. You should become familiary with the equipment before making any measurement or tests. Keep in mind that in defective equipment voltages may be present at unexpected points..... If servicing of these wattmeters is ever required, it will be necessary to isolate them from the AC line with an isolation transformer such as the VIZ WP-27A, WP-28, WP-29A, WP-30 or WP-32. This is because the circuitry of these instruments are connected directly to the AC line.

VIZ Repair Service

Authorized VIZ Service Depots throughout the United States are available for repair and calibration of VIZ Electronic Equipment. For up-to-date listings of these depots contact your VIZ Distributor, or write to VIZ Test Equipment, 175 Commerce Drive, Fort Washington, PA 19034. If it becomes necessary to service this equipment, fill out the Test Equipment Service order form supplied with the instructions.

1. Pack the test equipment carefully. The instrument should be double-packed. It is best to pack the unit in its original carton, or similar container, then "float" this carton in at least a 3-inch layer of suitable packing such as shredded paper, inside the outer carton.

2. A full description of the problem should be included in the request.

3. Include all probes, cables, and test leads used with the equipment.

Attention to these details will help prevent damage in transit and delay repairs.

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AC/RMS DIGITAL WATTMETERS
WD-766A 1KW, 10A WD-767 2KW, 20A

Description

VIZ Models WD-766A and WD-767 Digital Wattmeters are accurate low cost instruments designed for use in Engineering, Quality Control, and Production Test Departments to determine the power consumption of equipment operating directly from a standard 120 VAC, 60Hz line. Both instruments feature large L.E.D. displays.

In addition to power measurement, these wattmeters measure AC (RMS) voltage and (RMS) current.

Both instruments are house in a metal chassis and cover with provisions for rack mounting available as an option.

Specifications

		WD-766A	WD-767
Line Voltage Input		105-150 VAC	
Maximum Current	(RMS)	10A	20A
	(Peak)	20A	35A
Maximum Power		999W	1999W
Power Factor		.5 to unity	
Crest Factor	(Volts)	3:1@ 120VAC RMS	2.5:1@ 120VAC RMS
	(Amps)	4:1 @ 10A RMS	1.8:1 @ 20A RMS
Accuracy	(Volts)	1% ± 1 digit	.75 ± 1 digit
	(Amps)	1% ± 1 digit	
	(Watts)	1% ± 2 digit	
Resolution	(Volts)	1V	.1V
	(Amps)	.1A	.01A
	(Watts)	1W	1W
Frequency Response		40 Hz to 5 KHz	
Number of Digits		3	3.5
Display		Red LED .56" high	
Size	(inches)	5.75 x 5.8 x 8.5	
	(cm)	14.6 x 14.3 x 21.6	
Weight		4 lbs. (1.8kg)	

Operation

Note: Before operating these instruments, read this manual thoroughly and make sure that you understand and observe all safety instructions. The power on/off switch on the WD-766A/767 DOES NOT control the outlets on the front or rear panel. These outlets are 'HOT' as long as the power plug is plugged into a power source. Total combined current front and rear outlets not to exceed maximum current indicated on the front panel.

1. **VOLTAGE MEASUREMENT**

   To make a voltage measurement, press the "V" touch switch. The voltge L.E.D. indicator directly above the V switch will light. Read the display. The voltage measurement function will automatically be selected when the power is first turned on, or if power is interrupted for several seconds.

2. **CURRENT MEASUREMENT**

   To make a current measurement, press the "A" touch switch. The current L.E.D. indicator directly above the A switch will light. Read the display.

3. **WATTAGE MEASUREMENT**

   To make a wattage measurement, press the "W" touch switch. The watts L.E.D. indicator directly above the W switch will light. Read the display.

4. **POWER FACTOR MEASUREMENT**

   Read the Volts, Amps, and Watts and apply them to the following formula.

   P.F.=Watts (Volts x Amps)

Voltage Measurement

In the voltge measurement mode the output voltgae is sensed by the voltge divider comprised of R10 and R22. For a 120VAC output voltage, the voltage at the junction of R10 and R22 would be 120MVAC. This is fed through U1 SW-C to pin 4 of U6. U6 is a true RMS converter, and the output of US at pin 8 is a filtered D.C. voltage equal to the true RMS value of its input voltage. This D.C. voltage is coupled through U1 SW-A and then through R23 to the input of A/D converter U7, and finally to the display.

Current Measurement

In the current measurement mode the load current is sensed by R14. The voltage developed across R14 is proportional to the current being supplied to this load. This voltage is fed through R13 to pin 11 of U1 and through SW-d to pin 4 of U6. U6 is a true RMS converter, and the output of U6 at pin 8 is a filtered D.C. voltage equal to the true RMS value of its input voltage. This D.C. voltage is coupled through U1 SW-A and then through R23 to the input of A/D converter U7, and finally to the display.

Watts Measurement

In the watts measurement mode both load voltage and current are sensed. Voltage is sensed by R9 and R11 and fed through R8 to pin 10 of U2. Current is sensed by the parallel combination of R14 and R6/R12. The voltage at the wiper of R12, which is proportional to the load current is fed through R7 to pin 3 of U9. The gain of U9 is determined by R16 and R17, and is set at 24. The output at pin 6 of U9 is coupled directly to pin 4 of U2. U2 is a four quadrant analog multiplier, which provides an output at pin 8 equal to the instantaneous product of the voltages at pin 10 and pin 4. This output voltage is filtered by R4 and C1 and fed to pin 4 of U1, and coupled through SW-B and then through R23 to the input of the A/D converter U7, and finally to the display.

Meter and Display

The meter circuit consists of A/D converter U7 and BCD to seven segment decoder U8. The input voltage at pin 11 of U7 is converted into digital form and presented on pins 1, 2, 15, and 16. R26 is adjusted for an output of zero with zero input. R27 sets the gain of the converter. U7 also provides outputs at pins 3, 4, and 5 to strobe the displays.

The following test points (TP) are for your general information:
TP-1 = plus 15V. TP-2 = minus 15V. TP3 = minus 8V. TP-4 = plus 5V.

Switch/Logic Control

The selector switches S2, S3, and S4 are normally open momentary closed switches that determine which mode of operation the wattmeter is in. When either S2, S3, or S4 are depressed, U8 latches that signal and turns on Q1 for volts, Q2 for amps, or Q3 for watts. U8 also controls the switches of U1.

Power Supply

Internal power is supplied by transformer T1. A bridge rectifier comprised of CR1 thru CR4 provides plus and minus 15 volts D.C.. This voltage is stablized by CR6 and CR7. Another winding on T1 supplies voltage that is regulated to plus 5 volts D.C. by VR1. C8 and C9 provide stable operation of VR1.

Circuit Description

WD-767
2KW, 3.5 Digit Display

Voltage Measurement

In the voltage measurement mode the output voltage is attenuated by R10 and R11 along with U1A by a factor of 20. The voltage at pin 1 of U1A is further reduced by R37 and R36. For an output of 120 VAC the voltage at pin 8 of U7 would be 1.2 volts. This voltage is fed through U7 SW-C to pin 4 of U6. U6 is a true RMS to D.C. converter. The output at pin 8 of U6, which is now a D.C. voltage is fed through U7 SW-A and then through R29 to pin 31 of A/D converter U5.

Current Measurement

In the current measurement mode the output load current flows through R14. The voltage developed across R14 is proportional to the current. A portion of this voltage determined by R12 is applied to pin 5 of U1B and also through R16 to pin 4 of U3. The function of U1B is to provide a voltage signal gain of 25. U3 corrects any offset in the amplifier by feeding its output at pin 10 through R18 and storing a voltage across C12. This voltage will determine the level at pin 6 of U1B. The voltage at pin 7 of U1B, which represents load current is applied across R40, R23, and R24. A portion of that voltage at the wiper of R23 is fed to pin 11 of U7, through SW-D to pin 4 of U6.

Watts Measurement

In the watts measurement mode both load voltage and current are sensed. The voltage signal is taken from pin 1 of U1A, and the current signal from pin 7 of U1B. The voltage signal is applied to pin 10 of U2, and the current source to pin 3 of U2. U2 is a four quadrant analog multiplier, which provides an output at pin 8 equal to the instantaneous product of the voltge at pin 10 and pin 3. This output voltage is filtered by R4 and C1 and fed to pin U7, and coupled through SW-B and then through R29 to the input of A/D converter U5, and finally to the display.

Meter and Display

The complete meter and display function is performed by U5. U5 is a complete 3-1/2 digit A/D converter, that has all the necessary logic and drivers to control the L.E.D. displays U9 and U10. A reference voltage for U5 is set by R13 and applied to pin 36. This voltage is approximately 1 volt.

Switch/Logic Control

The selector switches S2, S3, and S4 are normally open momentary closed switches that determine which mode of operation the wattmeter is in. When either S2, S3, or S4 are depressed, U8 latches that signal and turns on Q3 for volts, Q2 for amps, or Q1 for watts. U7 also controls the switches of U1.

Power Supply

Internal power is supplied by transformer T1. A bridge rectifier comprised of CR1 thru CR4 provides plus and minus D.C. voltage to U4. U4 is a voltage regultor that provides an output of plus 15 volts and minus 15 volts. C8, C9, C19, and C20 provide stable operation of U4. Another winding on T1 supplies voltage that is regulated to plus 5 volts D.C. by VR1. C17 and C18 provide stable operation of VR1.

Calibration

These wattmeters were manufactured, tested, and calibrated under strict engineering supervision. If they should require repair or adjustment, it is recommended that they be sent directly to VIZ Test Equipment Company or one of our authorized service depots.

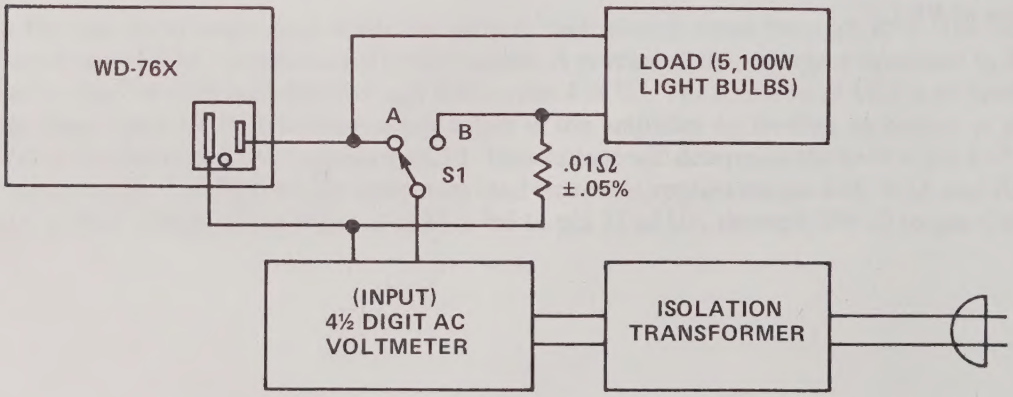
Component parts can be identified from the PC board layout and the schematic diagram included in this manual. Replacement parts are also listed and can be ordered from VIZ through your local dealer.

Calibration in the field is not recommended, however if the proper calibration equipment is available the following procedure can be used.

EQUIPMENT REQUIRED

1. A 4-1/2 Digit AC Voltmeter .05% Accuracy
2. A Precision Shunt Resistor .01% Ohm .05%
3. 5 ea. 100 Watt light bulbs (load)
4. 1 ea. SPOT Switch
5. Isolation Transformer (VIZ-WP-27, WP-28, WP-29A, WP-30 or WP-32)

Note: In order to calibrate these instruments remove the 8 screws holding the cover on. Remove the cover. Remove the 3 nuts that hold the circuit board to the front panel. The circuit board will drop back for access to the adjustments. After calibration reassemble.



Note: During all tests and calibration the 4-1/2 digit voltmeter must be isolated from the AC Power Line.

WD-766A CALIBRATION PROCEDURES

1. Allow a 10 minute warm up time.
2. With no load connected to the Wattmeter, perform the following two steps.
   A — Press the "A" touch switch and adjust R26 for a reaing of 00.0 on the display.
   B — Press the "W" touch switch and adjust R3 for a reading of 000 on the display.
3. Connect the load and equipment as shown in the diagram.
4. Place switch S-1 (fixture) in the "A" position.
5. Press the "V" touch switch on the wattmeter.
6. Adjust R-27 so that the reading on the wattmeter is the same as the one on the 4-1/2 digit voltmeter. Record this reading. ex 120.00 volts
7. Place switch S-1 (fixture) in the "B" position and record the reading on the 4-1/2 digit voltmeter. ex .0416 volts.
8. Calculate the load current using the formula I=E/R or in the example I= .0416 X R14= .01 = 4.16 amps
9. Calculate power consumption by multiplying the voltage reading (120.0) x the current (4.16) or 499 watts.
10. Press the "W" touch switch and adjust R-12 for a display equal to the power consumption ex. 499 watts.
11. This completes the calibration procedures.

WD-767 CALIBRATION PROCEDURES

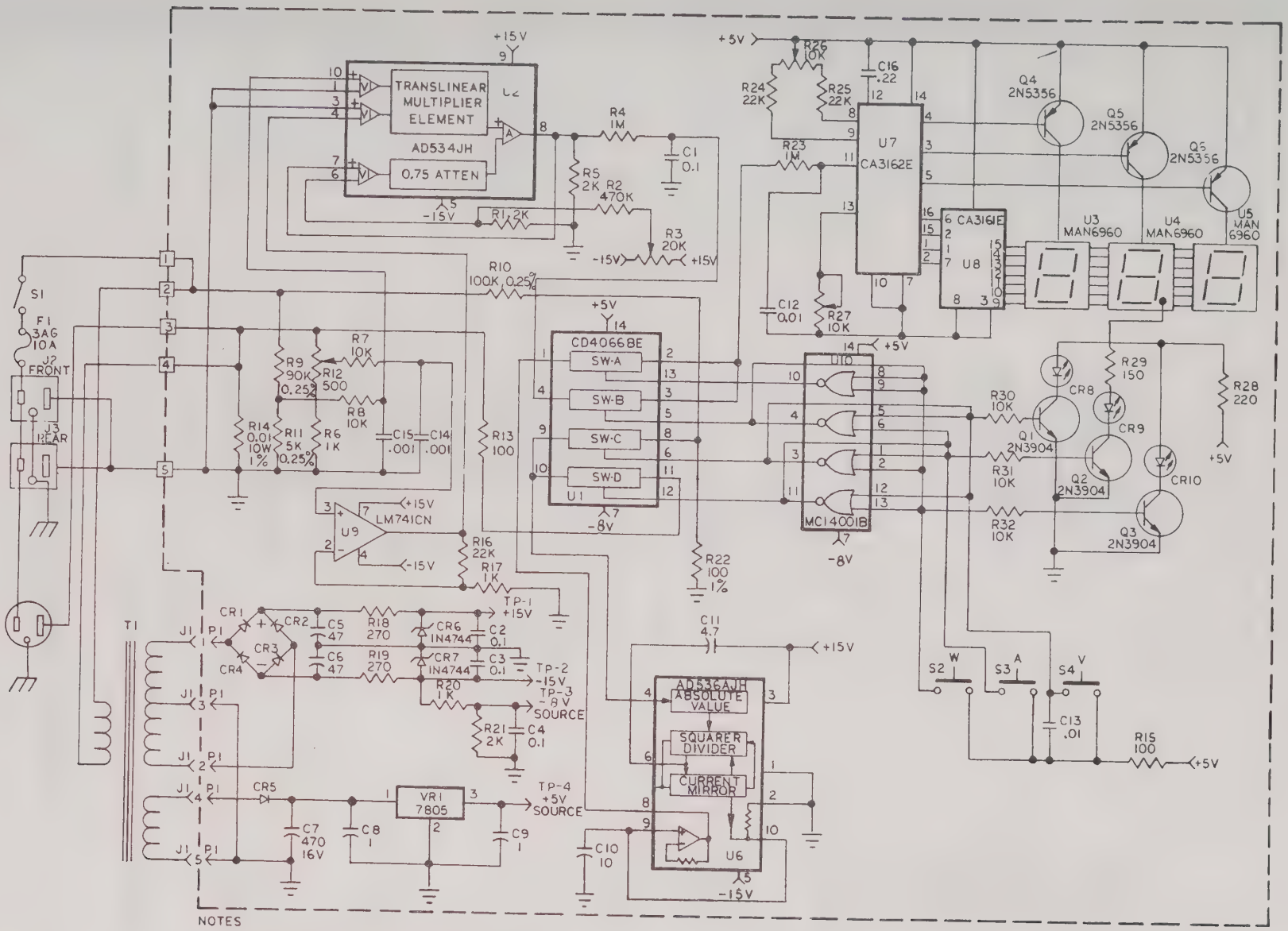
1. Allow a 10 minute warm up time.
2. With no load connected to the wattmeter perform the following — Press the "W" touch switch and adjust R-3 for a reading of 000 on the display.
3. Connect the load and equip. as shown in the diagram.
4. Place switch S-1 (fixture) in the "A" position.
5. Press the "V" touch switch on the wattmeter and adjust R0-13 so that the reading on the wattmeter is the same as the one on the 4-1/2 digit voltmeter. Record the reading. ex. 120.0 volts.
6. Place switch S-1 in the "B" position and record the reading on the 4-1/2 digit voltmeter. ex. .0416 volts
7. Calculate the load current using the formula I = E/R or ex. I = .0416 X R14=.01 = 4.16 amps
8. Calculate power consumption by multiplying the voltage reading (120.0) x (4.16) or 499 watts.
9. Press the "W" switch and adjust R-12 for a display equal to the power consumption. ex. 499 watts.
10. This completes the calibration procedure.

Replacement Parts List for WD-767A 2KW, 20A

Symbol N.	Description	Part No.
	Capacitors	
C1,2,3,4,5,6 7,8,9,10,11	Cap.p1 0.1mfd. 5% 10V	9187-126
C12	Cap.Tan 220mfd. 5% 10V Axial	9167-116
C13	Cap.disc 270pf 10%	9404-132
C14,15	Cap.elect. 47mfd. 35V Axial	9603-108
C16	Cap.elect. 470mfd. 16V Axial	9167-113
C17,18	Cap.tan. 1.0mfd 10% 25V Radial	1223-001
C19,20		
C21	Cap. mf 0.22mfd. 10%	9605-312
C22	Cap.Tan 4.7mfd. 30V Radial	9167-106
C23	Cap.Tan 10mfd 20$ 35V Radial	1315-086
C24	Cap.Disc 100pf 10% 1Kv	9327-118
C25	Cap.my 0.047mfd 10% 100V	1221-047
C26,27	Cap.Disc 0.01mfd 50V GMV	9327-116
	Resistors	
R1,5	2K 5% 1/4W	16-162021
R2,6	470K 5% 1/4W	16-164741
R3	Pot. 20K	9186-212
R4,29	1meg. 5% 1/4W	16-161051
R7	100K 5% 1/4W	16-161041
R8	2.2K 5% 1/4W	16-162221
R9	Prec. 9.53K 0.25% 1/4W	9167-121
R10	Prec. 100K 0.25% 1/4W	9167-122
R11	Prec. 5K 0.25% 1/4W	9167-123
R12,13,23	Pot. 500#	9186-207
R14	Res, Sens. 0.01# 1.0% 10W	9167-054
R15,18,24,25 26,27,28,39,40	1K 5% 1/4W	16-161021
R16,32,34,35	10K 5% 1/4W	16-161031
R17,21	Prec. 10K 0.25% 1/4W	9167-125
R19,22	Prec. 240K 0.25% 1/4W	9167-124
R20	20meg 5% 1/4W	16-162061
R30,31	150# 5% 1/4W	16-161511
R33	220# 5% 1/4W	16-162211
R36	Prec. 1K 0.25% 1/4W	9167-127
R37	Prec. 3.77K 0.25% 1/4W	9167-128
R38	1.5K 5% 1/4W	16-161521

Replacement Parts List for WD-767A 2KW, 20A

Symbol N.	Description	Part No.
	Diodes	
CR1,2,3,4,5,6	IN4007	11-040071
CR7,8,9	Led,Red HLMP-0301	9167-056
	Transistors	
Q1,2,3	Type 2N3904	12-03904
VR1	Regulator,Voltage 7805	9187-052
	Integrated Circuits	
U1	NE5532NE	14-055320
U2	AD534JH	14-005340
U3	ICL7650C	14-076500
U4	MC1468L	14-014685
U5	ICL7107C	14-071070
U6	AD536AJH	14-005361
U7	CD4066BE	14-040665
U8	MC14001B	9190-028
U9	Display MAN6130	9167-103
U10	Display MAN6110	9167-102
	Miscellaneous	
	Cord,Power,3Cond.	9632-040
	Strain Relief	9632-021
F1	Fuse Holder	9632-054
	Fuse 1A, 3AG	9416-148
P1	Header, 5pin	9670-123
J1,2	Outlet	9630-013
S1	Switch,Power	9167-059
S2,3,4	Switch,Pushbutton	9167-111
T1	Transformer,Power	9167-025
	Panel,Dress	9167-050
	Chassis	9167-023
	Cover	9167-032
	Feet,Bumper	9167-084



SCHEMATIC DIAGRAM WD-766A WATTMETER

NOTES

1. UNLESS OTHERWISE SPECIFIED:
   ALL RESISTOR VALUES ARE 1/4W IN OHMS, 5% TOL.
   ALL CAPACITOR VALUES ARE IN MICRO FARADS
   ALL DIODES ARE IN4007

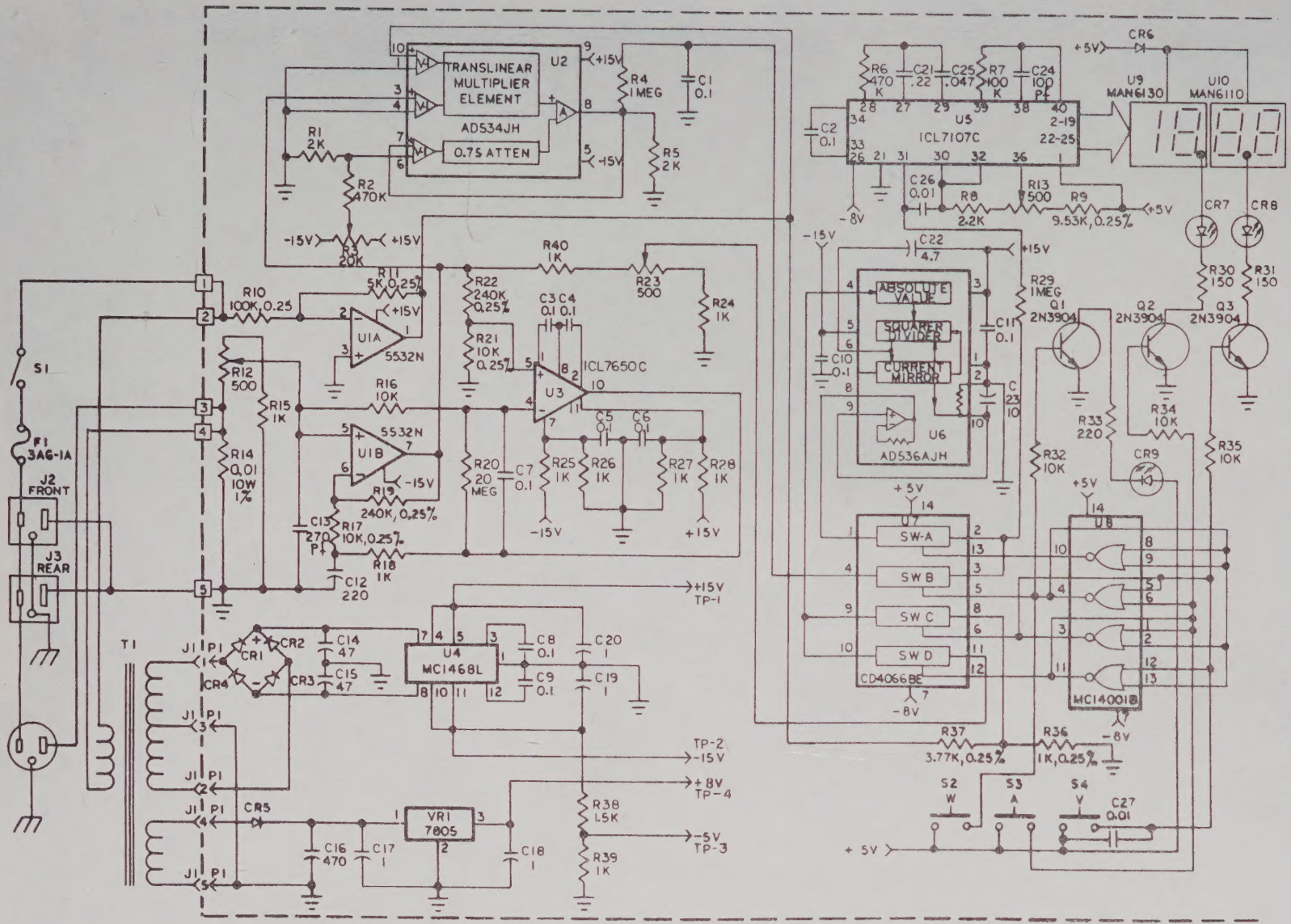
Replacement Parts List for WD-766A 1KW, 10A

Symbol N.	Description	Part No.
	Transistors	
Q1,2,3	Type, 2N3904	12-039040
Q4,5,6	Type, 2N5356	12-053560
VR1	Regulator, Voltage	9187-052
	Integrated Circuits	
U1	CD4066BE	14-040665
U2	AD534JH	14-005340
U3,4,5	Display, MAN6960	9605-221
U6	AD536AJH	14-005361
U7	CA3162E	9605-218
U8	CA3161E	9605-223
U9	LM741CN	14-007410
U10	MC14001B	9190-028
	Miscellaneous	
	Cord,power,3Cond	9632-040
	Strain Relief	9632-031
F1	Fuse,Holder	9632-054
	Fuse 1A,3AG	9416-148
P1	Header,5pin	9670-123
J2,3	Outlet	9630-013
S1	Switch,Power	9167-059
S2,3,4	Switch,Pushbutton	9167-111
T1	Transformer,Power	9167-025
	Panel,Dress	9165-050
	Chassis	9167-023
	Cover	9167-032
	Feet,Bumper	9167-084

Replacement Parts List for WD-766A 1KW, 10A

Symbol N.	Description	Part No.
	Capacitors	
C1,2,3,4	PL 0.1mfd. 5% 100V	9187-126
C5,6	Elect. 47mfd. 35V	9603-108
C7	Elect. 470mfd. 16V	9167-113
C8,9	Tan. 1.0mfd. 10% 25V	1223-001
C10	Tan. 10mfd. 20% 35V	1315-086
C11	Tan. 4.7mfd. 30V	9167-106
C12,13	Disc 0.01mfd. 50V GMV	9327-116
C14,15	Disc. .001mfd. 10% 1Kv	9327-119
C16	M.F. 0.22mfd. 10%	9605-312
	Resistors	
R1,5,21	2K 5% 1/4W	16-162021
R2	470K 5% 1/4W	16-164741
R3	Potentiometer 20K	9186-212
R4,23	1Meg 5% 1/4W	16-161051
R6,17,20	1K 5% 1/4W	16-161021
R7,8,30,31,32	10K 5% 1/4W	16-161031
R9	Precision 90K 0.25% 1/4W	9165-121
R10	Precision 100K 0.25% 1/4W	9167-122
R11	Precision 5K 0.25% 1/4W	9167-123
R12	Potentiometer 500#	9186-207
R13,15	100# 5% 1/4W	16-161011
R14	Sens. 0.01# 1% 10W	9167-054
R16,24,25	22K 5% 1/4W	16-162231
R18,19	270# 5% 1/4W	16-162711
R22	Precision 100# 1% 1/4W	9165-128
R26,27	Potentiometer 10K	9186-211
R28	220# 5% 1/4W	16-162211
R29	150# 5% 1/4W	16-161511
	Diodes	
CR1,2,3,4,5	1N4007	11-040071
CR6,7	1N4744 zener, 15V	11-047441
CR8,9,10	Led,Red HLMP-0301	9167-056

SCHEMATIC DIAGRAM WD-767 WATTMETER



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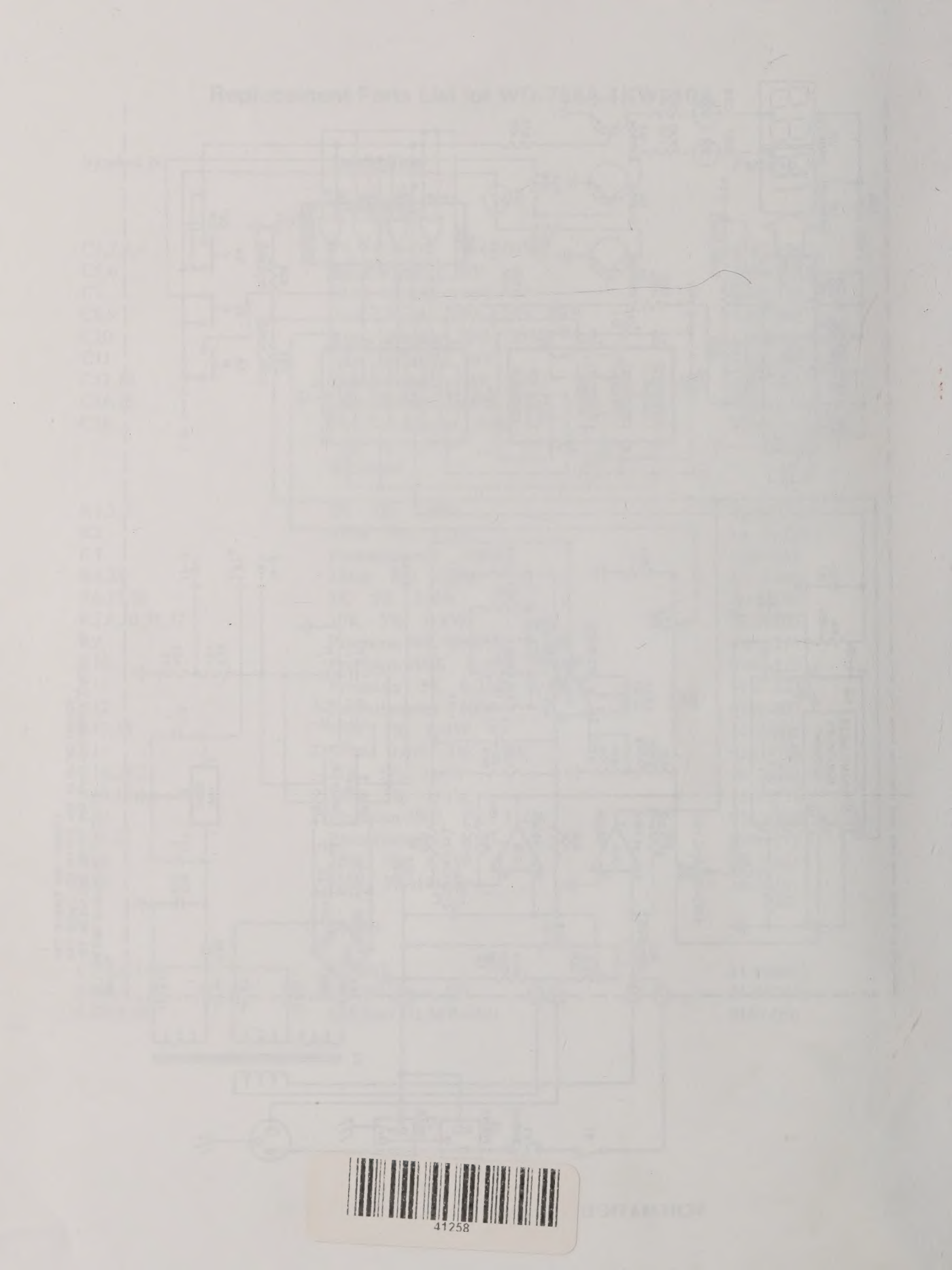
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